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Notes on North American Halorageæ.

BY THOMAS MORONG.

The order *Halorageæ* consists mostly of aquatic plants, and, as arranged by Bentham and Hooker, comprises nine genera, four of which occur in northern North America and one other in southern Mexico. These genera differ widely from each other in some important points, but so far as the structure of the ovules and embryos is concerned, form a very natural family. The Order was formerly classed by most botanists with the Onagraceæ, and in some botanical works many of the genera are still retained in that family, but they evidently differ radically from the members of that Order in nearly all the essential ordinal characteristics. *Ceratophyllum* was included among the *Halorageæ* by Bentham in his Flora Australiensis, but probably by mistake, as the peculiar embryo, the four verticillate cotyledons and the exalbuminous ovules of *Ceratophyllum* absolutely forbid its introduction into this group of plants. Curiously enough, too, Bentham's own ordinal description debars this genus from a place here.

The only objection to the arrangement of Bentham and Hooker which is likely to be made is in regard to the position of *Callitriche*, which has commonly been regarded as unique and as constituting an Order by itself. Upon a careful examination, however, it cannot be doubted that in habit, in its four-carpelled fruit, its ovules and embryos, this genus bears a very close relationship to *Myriophyllum*, while in the stamens and styles it strikingly resembles *Hippuris*, especially those forms of *H.*

montana which are monoecious. By some good judges, *Callitriche* has been included among the *Euphorbiaceæ*, with which, indeed, it has affinities, but from which it is widely divergent in having two styles and four-celled, indehiscent fruit, as well as in other characters.

The species as found in our country are, as a rule, strictly aquatic, but not invariably so, as a few of them grow on mud or moist ground by the side of streams or ponds, and two species of *Callitriche* make their home under the shade of houses or in the woods.

About thirty species are found in Canada and the United States.

The genera agree in having pendulous, anatropous ovules, nut-like or drupaceous, indehiscent, angular, costate or winged seeds, and a fleshy albumen with the embryo in its axis.

They may be briefly distinguished as follows:

Stamens one.
  Ovary one-celled. Leaves verticillate, linear or obovate. 1. *Hippuris.*
  Ovary four-celled. Leaves opposite, linear or spatulate. 2. *Callitriche.*
Stamens two to eight.
  Fruit triangular. Leaves alternate, pectinate or pectinate-pinnatifid. 3. *Proserpinaca.*
  Fruit four-sided. Leaves verticillate, subverticillate or scattered. The emersed entire, toothed or pectinate, the submerged pinnatifid. 4. *Myriophyllum.*

1. *Hippuris.* L. Gen. Pl. n. 1. (1737).

Flowers small, axillary, perfect, or by abortion sometimes neutral or pistillate. Apetalous. Calyx tube adherent to the ovary, the limb minute, entire. Stamens one, in the perfect flowers inserted on the margin of the calyx. Style filiform, stigmatic its whole length, and lying in a groove of the anther. Drupe one-celled, one-seeded. Only three species are known, all occurring in North America

Leaves linear, acute, six to twelve or more in a whorl. 1. *H. vulgaris.*

Leaves usually oval or obovate, obtuse, four to six in a whorl. 2. *H. tetraphylla.*

Very small Arctic plants, with linear, mucronate leaves, five to six in a whorl. 3. *H. montana.*

1. *H. vulgaris.* L. Sp. Pl. 4. (1753).

Springing from a perennial rootstock, with annual, simple, erect stems and whorls of six to twelve or more one-nerved linear or lanceolate leaves which are more or less decayed (sphacelated) at the tips, and 10-20 mm. long by 1-3 mm. broad. Stamens with short, thick filaments and comparatively large two-celled anthers, which dehisce laterally. Fruit oval, or somewhat four-sided, hollow in the interior, 2 or 3 mm. long, stigmas persistent. Common in Arctic America and Canada, It occurs also in Moosehead Lake, Maine (Porter), west to Oregon, and thence to California (Parish) and New Mexico. Mr. Safford sends it from the Straits of Magellan, and it is common in Europe and Central Asia.

Var. fluviatilis. Hart. Scand. Fl. 150 (1849).

A very luxuriant, deep water form, entirely or nearly submerged. Leaves 6 cm. long by 2-3 mm. wide, grass-like, numerous, in closely crowded whorls. Lake Winipeg (Macoun), Keweenaw Peninsula, Michigan (Robbins) and Oregon (Lyall). Not uncommon in Sweden.

2. *H. tetraphylla.* L. f. Supp. 81 (1781).

H. lanceolata. Retz. Obs. Fasc. 3, 7, t. 1 (1783).

H. maritima. Hell. Dis. Hipp. in Ust. Opusc. I. 11. t. 1 (1786).

This is usually a smaller plant than the preceding, rarely attaining a height of over 20 cm. Sometimes, however, as in Labrador specimens, twice that height. The leaves are in whorls of fours or sixes, oval, obovate or occasionally oblanceolate, but little, if at all, decayed at the tips, and often feather-veined. Fruit less than 2 mm. in length. It ranges from Alaska and Hudson's Bay to the Gulf of St. Lawrence, and from Sweden to Siberia.

3. *H. montana.* Ledeb. in Reich. Bot. 1. 71 (1827).

This diminutive northern plant, as Torrey and Gray remark, (Fl. N. A. p. 531), looks very much like a small *Galium.* Stems 3-6 cm. high. Leaves one-nerved, linear, mucronate, in fives or sixes, 5-6 mm. long, not decayed at the tips. Often monoecious, the flowers consisting of a single stamen or a single pistil; sometimes all the flowers in the axils of the whorls staminate. Stamens as long as the ripe fruit; filaments thick: anthers large. Fruit almost oval, minutely granulated, a little over 1 mm. in length; the persistent style shorter than the nutlet.

Turfy places in Siberia, Alaska and the Selkirk Mountains, British Columbia (Macoun).

2. *Callitriche.* L. Sp. Pl. 969. (1753).

Widely dispersed over the earth in warm and temperate climates. As usually reckoned, it numbers about twenty species, one half of them occurring in the United States. In some cases, however, the species run so close to each other that they can be distinguished only by fruit markings. In this paper Hegelmaier's classification of our North American forms is retained more for the sake of avoiding the creation of new synonyms than for any other reason. A stricter grouping would probably throw *C. verna*, *C. stenocarpa*, and *C. Bolanderi* into one. It is doubtful, too, if *C. verna* and *C. heterophylla* should be considered as distinct species, since they can be separated only by the fruit, and are constantly confounded. Each of them, also, varies more or less in the shape of the fruit, so that it is not always easy to place the specimens.

The leaves of most or all the species are covered on both sides with dark, colored dots termed by Engelman "stellate scales," and by Hegelmaier "stellate hairs." Under the microscope they appear to be composed of a dark ring in which is a slightly sunken disc with a minute cell in the centre from which radiate lines dividing the disc into several cells. They are more numerous in the aquatic than in the terrestrial species, in the former usually having four cell divisions, and in the latter eight, or sometimes split into twice as many divisions.

Authors have generally regarded the flowers as monoecious, calling the stamens and pistils separate flowers, although they may stand side by side in the same axil and enclosed in the same perigonium. In respect to this I am bound to say that I agree with Mr. Joseph Schrenk,* who observes " there is no reason why we should separate these two organs and call them two different flowers, when, in fact, they could not be any more closely connected than they really are." In the perfect flowers the stamens are clearly hypogynous, proceeding, as Mr. Schrenk states, from the same vascular bundle of which that of the pistil is a branch.

The flowers in most of the aquatic species are enclosed in a pair of small falcate or semilunar membranous bodies, which are by most authors termed bracts, by some a perianth, and by Mr. Schrenk in the article referred to floats. It is not easy to decide certainly upon the office of these bodies, but the explanation of Mr. Schrenk is ingenious and has several good reasons in its favor. That they are sacs containing air is evident. They are also most vigorous in the rosette of floating emersed leaves, where they would be of most service if really intended to impart buoyancy to the plant, decaying or shrivelling as the stem elongates. Another thing which seems to confirm this theory is the fact that they are wanting in the terrestrial species, but then, on the other hand, this is equally true of *C. autumnalis*, which is entirely submerged. Whatever may be the truth in regard to these bodies, we may properly speak of them as perigonial sacs.

As a rule, the flowers of *Callitriche* are diclinous, consisting of a single stamen or a single pistil, but in some species they will be either all perfect, or, whenever the stamen is lacking, two pistils in the same axil. Filaments elongated ; anthers reniform, two-celled, dehiscing by side slits which finally flow into one across the top. Styles two, filiform, papillose. Fruit sessile or on peduncles, which in some species are greatly elongated at maturity, compressed, four-celled, more or less winged or keeled on the margins, four-lobed, the lobes united in pairs so as to form two discs with a groove between them, separating at maturity into four flattish carpels, each containing a single seed.

Fruit pedunculate.

Perigonium none.

Peduncles minute, ⅕-⅘ mm. long.

1. *C. deflexa*, var. *Austini*.

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* See his article in Bot. Gaz., 13, 296.

Peduncles stout, spreading, 2-5 mm. long. 2. *C. marginata.*

Peduncles deflexed, 2-5 mm. long, fruit rooting in the mud.

Leaves spatulate, three-nerved. 3. *C. Nuttallii.*

Leaves linear, one-nerved. 4. *C. sepulta.*

Enclosed in a perigonium. Peduncles very long. 5. *C. longipedunculata.*

Fruit sessile.

With a perigonium.

Fruit oblong, narrowly winged on the apical margin, flat on the face, styles shorter than the fruit and deciduous. 6. *C. verna.*

Fruit obovate, wings nearly wanting, plano-convex on the face. Styles longer than the fruit, persistent. 7. *C. heterophylla.*

Fruit with broad membranous wings which run around the entire margin. Styles elongated, deciduous. 8. *C. stenocarpa.*

Fruit orbicular, margins obtuse. Styles elongated, mostly deciduous. 9. *C. Bolanderi.*

Without a perigonium.

Leaves all submerged and linear. 10. *C. autumnalis.*

Leaves all spatulate. Fruit curiously gibbous at the base. 11. *C. peploides.*

1. *C. deflexa.* Braun, var. *Austini.* Hegelm. Verhandl. Bot. Brand. p. 17 (1867).

C. Austini. Englm. Gr. Man. Ed. 5, 428 (1867).

Terrestrial, 2-4 cm. high, growing on damp soil in shady woods. Leaves spatulate or obovate, three-nerved, 3-4 mm. long and nearly or quite 2 mm. broad, tapering at base into a short margined petiole. Fruit about $\frac{5}{10}$ mm. long by $\frac{8}{10}$ mm. broad, deeply notched at both ends; lobes with a narrow marginal wing or raised border and a deep groove between them; usually with a minute peduncle nearly or quite their own length. Styles persistent, shorter than the fruit, spreading or reflexed. The dried plant exhales a pleasant odor like that of *Melilotus.*

Several forms occur in Brazil, distinguished mainly by the length of the peduncle, the one regarded by Hegelm. as the type with peduncles 3-5 mm. long, and fruit somewhat larger than in ours.

New York to Washington, D. C., west to Missouri, Arkansas, Louisiana and Texas, Central and South America.

2. *C. marginata.* Torr. Bot. Whip. Ex. 135 (1856). Hegelm. Verhand. Bot. Brand. 9, 12 (1867.)

Amphibious, usually floating, sometimes growing in mud. Submerged leaves linear, one-nerved, running gradually into the emersed, which are oblanceolate or spatulate, and three-nerved, the blade 4-6 mm. long and about 2 mm. broad. Styles as long as or shorter than the fruit, reflexed, deciduous. Fruit 1-1¼ mm. long and 1½-1¾ mm. broad, with conspicuous membranous wings and divergent lobes.

Peculiar to the Pacific coast from Arizona to California. Also attributed to Chili.

3. *C. Nuttallii.* Torr. Bot. Whip. Ex. 135 (1856).

C. pedunculosa. Nutt. Trans. Am. Phil. Soc. Vol. V, n. s. 140 (1837) not Arnott nor *C. pedunculata,* D.C.

A small terrestrial species growing in moist grounds. Leaves all spatulate, three-nerved, the blade 3 or 4 mm. long and 1-1½ mm. broad, often finely wrinkled or granulated, apparently without stellate scales. Fruit thick, deeply emarginate at apex and base, ⅗-⅘ mm. in length and ⅘-1 mm. in breadth, the lobes with narrow marginal keels. Styles erect, longer than the fruit, deciduous. This and the following species are peculiar in bearing the fruit on reflexed peduncles and burying it in the mud.

First discovered by Nuttall in Arkansas and described by him under the name *C. pedunculosa,* but, unfortunately, the name had been already preoccupied.. It extends down the Mississippi to Louisiana. (Hale, Langlois.)

4. *C. sepulta.* S. Watson. Proc. Am. Ac. 14, 298 (1879.)

A small terrestrial prostrate species, similar in general appearance and habit to the preceding. Leaves linear, one-nerved, 3-5 mm. long, somewhat wrinkled or granulated below, as in *C. Nuttallii,* and apparently without stellate scale. Styles elongated, reflexed, soon deciduous, Fruit thick, about ¾ mm. long and

1 mm. broad, with very narrowly winged, divergent lobes, deeply emarginate at both ends, usually somewhat smaller than in the preceding species.

Oregon. Coll. E. Hall (No. 459) 1871.

5. *C. longipedunculata*, n. sp.

With thread-like stems; leaves all spatulate or oblanceolate, 3-8 mm. long, the blades 1-2 mm. broad, rounded at the apex and sloping into narrowly margined petioles often longer than themselves, dotted with stellate scales, three-nerved, the lateral nerves running into each other very near the apical margin. Perigonial sacs longer than the fruit. Styles much longer than the fruit, erect, deciduous. Peduncles lengthening to 10-25 cm. at maturity, and frequently two or three proceeding from the same axil, or a little below it. Fruit thick, nearly orbicular $\frac{3}{5}$-1 mm. long by about $\frac{4}{5}$ mm. in breadth, minutely emarginate, the lobes divergent, with a deep intervening groove, obtusely margined, and with or without a very narrow wing. Nearly allied to a species in the Torrey Herbarium from Constantinople labelled "*C. muscoides*, Goldbach," which has peduncles nearly as long, but with different leaves and fruit. A well marked species, collected in 1884 by C. R. Orcutt, on mesas, San Diego, California.

6. *C. verna*. L. Fl. Suec. ed. 2, 2 (1755.)

C. vernalis. Koch. Syn. ed. 1, 245 (1837) not Kütz.

Chiefly aquatic, and quite variable. Leaves of two kinds, the submerged narrow, linear, one-nerved, retuse or bifid, 10-20 mm. long, gradually changing into the emersed, which are three-nerved, 8-12 mm. long, the blade 3-4 mm. broad, spatulate or obovate, rounded and truncate or retuse at the apex, narrowing into a margined petiole, and profusely dotted with stellate scales. South American forms figured by Hegelm. have rhomboid-spatulate leaves. A terrestrial form, growing in places from which the water has receded, much smaller and more compact, has tri-nerved, obovate leaves 3-4 mm. long, and 1-2 mm. broad. There is also an entirely submerged form with the leaves all linear.

Styles chiefly shorter than the fruit, spreading, deciduous. The typical fruit of this species is oblong in shape, 1-1¾ mm.

long and ¾-1 mm. broad, flat on the face, mostly with a small apical notch and narrow apical wings, the grooves between the lobes deep. The fruit often varies from oblong to obovate, thus approaching the character of the following species.

To the terrestrial form of this species have been referred *C. brevifolia*, Pursh., and *C. terrestris*, Raf., and to the submerged form *C. linearis*, Pursh., but no one can tell without an examination of their specimens whether these authors had this or the following species in mind.

A wide-spread species, but most common in Northern waters. It occurs throughout the Dominion of Canada, and in nearly all parts of the United States. Found also in South America, Europe and Asia.

7. *C. heterophylla.* Pursh. Fl. Am. 1, 3 (1814.)

C. Asagrayi. Hegelm. Monog. p. 54 (1864.)

Very similar to No. 6 in general appearance, foliage and habits; like that it has terrestrial, submerged and intermediate forms. Fruit smaller, $\frac{3}{5}$-1 mm. long by $\frac{4}{5}$-$1\frac{1}{5}$ mm. broad, generally obovate, with a deep, broad notch at the apex, thick, almost ventricose near the base, lobes obtusely angled, with a small groove between them, wingless or with a narrow wing or raised border on the upper margin; stigmas usually longer than the fruit, erect, more or less persistent.

Frequently confounded with *C. verna.* After examining many private collections, and finding fault with the collectors for badly mixing up the two species, I was somewhat taken aback, as well as much amused, upon re-examining my own specimens collected some years since, to find that nearly all which I had marked *C. verna* were *C. heterophylla.*

This species is more common than the foregoing in Southern waters, but it occurs in Canada, and ranges from New England to Florida and Louisiana, and west to Missouri and Colorado.

8. *C. stenocarpa.* Hegelm. Verhand. Bot. Brand 10, 114 (1868 ?).

Floating leaves 10–12 mm. long, obovate, rounded and entire at the apex, three-nerved, the blade 8-10 mm. long and about 4 mm. broad, tapering into a short, margined petiole, marked with stellate scales. Submerged leaves linear. Styles erect, twice as long as the fruit, deciduous. Fruit flat, with a well marked wing on the lobes which runs into the apical notch and all around the margins, $1\frac{1}{5}$-$1\frac{2}{5}$ mm. long and 1-$1\frac{1}{5}$ mm. broad. The fruit is thinner than in *C. verna*, and the lobes less divergent, the groove about as deep. Collected by Prof. E. L. Greene near Donner Lake, Sierra Nevada, California.

9 *C. Bolanderi.* Hegelm. Verhand Bot. Brand 10, 114 (1868 ?).

Usually more branching, with larger stems and leaves than in *C. verna*, but similar to that species in general appearance and habit. Floating leaves obovate or rhombic-obovate. Fruit orbicular or slightly obovate, 1-1½ mm. in diameter, or sometimes a little longer than broad, the lobes scarcely winged, with sharp or obtuse closely approximated margins. Styles twice as long as the fruit, erect, persistent or subpersistent. A Pacific coast plant, occurring at Vancouver's Island, and other places in British Columbia, Oregon, (Hall No. 460), Washington, Placer County, (Bolander) and other places in California.

10. *C. autumnalis.* L. Sys. Nat. 2, 52, No. 13 (1767).
C. angustifolia. Hoppe. Bot. Tasch. 155 (1792).
C. virens. Gold. Act. Mosq. 5, 119 (1817).

Plant entirely submerged, very bright green when fresh, often growing in rapids. Leaves entirely destitute of stellate scales, crowded on the stem, linear-lanceolate, broader and clasping at the base, retuse or bifid at the apex, one-nerved, 10-15 mm. long. Styles about as long as the fruit, reflexed and soon deciduous. Fruit sessile or occasionally on a minute peduncle, slightly narrower than long, or orbicular, 1-2 mm. in diameter, the lobes with a deep groove between them which extends half way to the centre of the fruit, and broad wings on the margins.

Extensively diffused in northern regions. Common in Canada and British Columbia. It occurs in western Massachusetts, (Gr. Man. Ed. 6) Lake Champlain (Pringle), Sault Ste. Marie (Morong), South Colorado (Brandegee), and Harney Valley, Oregon (Howell).

11. *C. peploides.* Nutt. Trans. Phil. Soc. n. s. 5, 141 (1837).
C. Drummondi. Hegelm. Monog. 60 (1864).

A small species, creeping in mats 2-4 cm. upon moist ground, often under the shade of dwelling houses. Leaves all obovate or oblanceolate, 2-5 mm. long, ½-3½ mm. broad, the blades rounded at the apex and tapering into a short petiole, three-nerved. Style as long as or longer than the fruit, erect, deciduous or persistent. Fruit very small, sessile or on a minute peduncle, entirely unlike that of any other species, being only about $\frac{3}{5}$ mm. long by $\frac{4}{5}$ mm. broad, the lobes separated by a deep and broad apical notch, the groove between them small, the margins obtuse and wingless, contracting at the base into a raised, gibbous projection. The dried plant has a fragrance like that of No. 1.

Florida, Arkansas, Louisiana, Texas. Also in Cuba (Wright., Rugel, No. 234).

3. *Proserpinaca.* L. Act. Up. 81 (1741).

Well-known marsh or aquatic plants readily recognized by their three-celled bony triquetrous fruit. It should be noted, however, that the flowers are in rare cases four-parted, and when this occurs, the fruit is four-gonous, four-celled and four-seeded. The inflorescence is in the axils of the emersed leaves. Two species only are known, confined to North America.

Emersed leaves linear or linear-lanceolate, sharply serrate, the submerged pectinate or pectinate-pinnatifid. Fruit sharply three angled, the faces concave and usually smooth. 1. *P. palustris.*

Leaves all pinnate or pinnatifid. Fruit smaller, angles obtuse, the faces flat or slightly convex, apt to be wrinkled or tuberculate. 2. *P. pectinata.*

1. *P. palustris.* L. Sp. Pl. 88 (1753).

Trixis palustris. Gaert. De Fruct. 115, t. 24 (1788).

The submerged plants of this species may be distinguished from those of the following by the fact that the segments are commonly denticulate, and bear minute black spines in their axils, while this seldom occurs in the other.

Common in Canada, New England south to Florida, New Mexico and Gautemala, west to Minneapolis and Iowa, Cuba (Wright).

2. *P. pectinata.* Lam. Ill. t. 50, f. 1 (1791).

P. pectinacea. Torr. and Gray Fl. 1, 76 (1838). Gray Man. Ed. 6 182 (1890) not Lam.

This plant grows about as high as the preceding (20-50 cm.)

but with a more limited range, occurring in sandy ponds along the Atlantic coast from Southern New England to Florida and Louisiana.

In order to compare the number of spinulose teeth in the submerged leaves of the two species, fourteen of each were taken at random and examined. In *P. palustris* thirteen plants had them on nearly all the leaf segments and one bore them occasionally, while in *P. pectinata* eleven were entirely destitute of them, and three showed them occasionally, and these so minute as to be scarcely discernible under a lens.

4. *Myriophyllum*. L. Gen. Pl. n. 724 (1737).

Leaves for the most part verticillate (alternate in No. 4), the emersed bract-like, entire, toothed or pectinate, the submerged long, pectinate-pinnatifid, with fine capillary divisions. Flowers axillary, commonly monoecious, the staminate above with a very short calyx tube, and two to four-lobed limb or none. Petals two to four. Stamens four to eight. The intermediate flowers not unfrequently perfect. Calyx of the fertile flowers with a more or less deeply four-grooved tube, and four minute lobes or none. Ovary two to four-celled, having a single pendulous ovule in each cell. Styles four, short, often plumose and recurved. Drupe four-sided, splitting at maturity into four crustaceous, one-seeded, indehiscent carpels, which are smooth, angled or tuberculate on the back.

Fifteen or twenty species are known, inhabitants of fresh water in all parts of the world, both in the tropics and the frigid zone.

Twelve species occur in North America, which may be briefly characterized as follows:

Carpels smooth.
- Flowers on emersed spikes.
  - Floral leaves shorter than the flowers. Spikes nearly naked.
    - Flowers in verticils. 1. *M. spicatum*.
    - Flowers alternate, or subverticillate below. 2. *M. alterniflorum*.
  - Floral leaves longer than the flowers, pectinate-pinnatifid. 3. *M. verticillatum*.

Floral leaves reduced to minute bracts. 4. *M. tenellum.*

Flowers on both emersed and submersed stems.
5. *M. humile.*

Flowers on submerged stems. 6. *M. proserpinacoides.*

Carpels ridged or rough.

Flowers on emersed spikes.

Floral leaves ovate or lanceolate, serrate or entire.
7. *M. heterophyllum.*

Floral leaves linear-lanceolate, serrate or entire. Pacific coast plants. 8. *M. hippuroides.*

Floral leaves linear, pectinate toothed. 9. *M. pinnatum.*

Floral leaves pinnately parted, longer.
10. *M. Mexicanum.*

Floral leaves reduced to minute, nearly entire, spatulate bracts. 11. *M. laxum.*

Flowers on submerged stems. 12. *M. Farwellii.*

1. *M. spicatum.* L. Sp. Pl. 992 (1753).

Submerged leaves in whorls of fours and fives, the capillary divisions usually coarser than in No. 2 and No. 3. Floral leaves ovate, entire or toothed, commonly shorter than the flowers, sometimes none, leaving the spike nearly or quite naked. Spike 3-7 cm. in length. Petals four, deciduous. Stamens eight. Fruit 2½ mm. long and 2-3 mm. broad. Carpels rounded on the back, with a deep, wide groove between them. Very rarely the carpels are somewhat rugose. A deep water plant.

Common in Canada from Bear Lake to Newfoundland, New England to Minnesota, Utah and California, south to Florida. Common in Europe.

2. *M. alterniflorum.* DC. Fl. Fr. Supp. 529 (1805). Prod. 3, 68 (1828).

Submerged leaves usually in whorls of threes and fives, occasionally scattered, 6-10 mm. long, eight to ten pairs of pinnæ, the whole outline of stem and leaves narrow, 5-15 mm. in width. Spikes short, 3-5 cm. long, numerous on the branching stems. Uppermost floral leaves minute, ovate or linear, entire or minutely toothed, smaller than the flowers, early deciduous, leaving the fruiting spike naked. All the uppermost floral leaves and flowers alternate. Staminate petals four, longer than the stamens, oblong, pale, rose-colored, deciduous. Stamens eight. Fruit looking like a square block, 1½ mm. long and broad. Carpels turgid, rounded on the back with a deep intervening groove. A deep water plant.

Greenland, Lake Termiscouata (Northrop), and Lake Memphremagog, Canada, near the United States boundary (Churchill). Common in Europe.

3. *M. verticillatum.* L. Sp. Pl. 992 (1753).

Submerged leaves in crowded verticils of threes and fours, 1 to 4 cm. long, the capillary divisions ten to twelve pairs, often minutely scabrate. Floral leaves pectinate-pinnatifid, or pectinate, much longer than the flowers. Petals four, purplish in color on the sterile flowers. Stamens eight. Fruit 2 to 3 mm. long, and 2½ mm. broad, somewhat gibbous at the base.

In deep and shallow water. Ontario (Macoun's Cat.). Same range in United States as No. 2. Common in Europe.

4. *M. tenellum.* Big. Fl. Bost. 346 (1824).

Stems slender, scape-like, nearly leafless, simple, erect, 4 to 35 cm. high, nearly all out of the water, from a long rhizome, which sends up many sterile shoots. Flowers alternate, solitary, subtended by small, entire bracts, the uppermost obovate and often longer than the flowers, the lower oblong and generally shorter than the flowers, the lowest part of the spike often bractless. Stem with scattered bracts or often naked. Staminate petals four, longer than the stamens, somewhat persistent, purplish in color. Stamens four. Fruit 1 mm. long and 1 mm. broad at the apex, spreading to 1½ mm. at the base. Carpels rounded or obtusely angled on the back, the groove shallow.

Frequent in Canada, New England, New York, Pennsylvania, and west to Michigan.

5. *M. humile.* (Raf).

Purshia humilis. Raf. Med. Rep. 2nd. Hex. 3, 422 (1806).
M. ambiguum var. limosum., Nutt. Gen. 2, 212 (1818). Torr. Comp. 355 (1826). Gr. Man. Ed. 1, 140 (1848).

This plant occurs in several forms according to the situation in which it grows. These forms, when seen only in dried herbarium specimens, might be easily mistaken for distinct species, so different are they in general appearance. Each of them has received a varietal name, but they can hardly be considered as anything more than forms or states, as they readily run into each other when the conditions change.

The type of Rafinesque, commonly called by late authors var. *limosum*, is entirely terrestrial, rooting in the mud upon the shore, 2 to 4 cm. high, leaves much longer than the fruit, alternate, linear, and entire or more commonly pectinate, sometimes pinnatifid. Fruit minute, slightly more than 1 mm. long and 1 mm. or less in breadth. Carpels usually smooth, sometimes a little rough, the groove small. Petals four, purplish. Stamens four. This form appears to be the offspring of the floating plant which often roots in the mud where it is cast ashore, and sends up an erect flowering stem, frequently leaving traces of the old submerged leaves below the rooting node.

The form called *M. ambiguum* var. *natans* by Dr. Gray (Man. Ed. 1, p. 140) and which he seems to have considered the type, is intermediate between the type and the so-called var. *capillaceum*. It usually occurs in still, shallow water, with a spike of flowers and the typical floral leaves above the surface, and subverticillate or, more commonly, scattered pinnatifid leaves beneath ; the divisions are few. On specimens of this from the herbarium of Mr. Oakes, marked by him *M. capillaceum*, Nutt., I find spikes nearly 30 cm. long. When botanizing on Nantucket in the summer of 1887, I found these aquatic forms together in some of the small ponds, growing in such profusion that they were literally in heaps. A note sent to Mrs. Owen, and published on page 26 of her interesting catalogue of the plants of the island, will show how intimately associated they are.

" In both these ponds the plant is at first var. *capillaceum* while immersed, but very soon it gets its head above water and immediately forms pectinate leaves—that is becomes the type as described in Gray's Manual. I have plenty of specimens in both conditions which grew together."

The form called *M. ambiguum* by Nutt. (Gen. 2, 213) and *M. ambiguum*, var. *capillaceum* by Torr. & Gray (Fl. N. A. 1, 543) and other authors, is commonly a deep water plant, entirely submerged. Stems long, widely branching, very plumose when growing, leaves all pinnatifid with hair-like divisions, subverticillate or scattered. It rarely flowers or fruits, and when it does the inflorescence may be seen scattered here and there in the axils of the leaves. One or more of the forms occur from eastern Massachusetts to Maryland and Tennessee, and west to Illinois and Indiana.

6. *M. proserpinacoides.* Gill. in Hook. Bot. Misc. 3, 313 (1833).

This is a South American species introduced from Chili or Buenos Aires, where it is a native. It has partially naturalized itself in Hopkins' pond, near Haddonfield, and other places in New Jersey, and seems to be spreading. All the plants occurring in our waters appear to have sprung from stock imported several years ago by the florist, Mr. E. D. Sturtevant, of Bordentown, New Jersey, who writes that " it is entirely hardy here, below the reach of ice or frost."

Hooker describes it as monoecious and diœcious. I have seen only pistillate plants. These are very vigorous, 10 to 40 cm. high, even lifting themselves out of the water and growing quite as well above as below it. Normally, however, it seems to be a submerged plant. Leaves all alike, smooth, glaucous, pectinate-pinnatifid, in crowded verticils of fives, 15 to 20 mm. long, pinnæ linear, twenty to twenty-five in number, the pairs opposite or subopposite, each segment about 5 mm. long, and sharply pointed. Stamens said by Gillies to be eight. Pistillate flowers axillary, about 1 mm. high, without petals, with four white plumose stigmas. Fruit not seen, but as indicated by the ovaries, the carpels should be smooth. Between the bases of the leaves and among the flowers are many small white trichomes, or hair-like bracts.

7. *M. heterophyllum.* Michx. Fl. 2, 191 (1803).

Potamogeton verticillatum. Walt. Fl. Car. 90 (1788).

Floral leaves in whorls of threes and fives, linear, ovate or lanceolate, serrate or rarely entire, much longer than the flowers, sometimes as much as 18 mm. in length and 4 mm. broad; submerged leaves verticillate or subverticillate, crowded, about 2 cm. long, with six to ten pairs of capillary pinnæ. The flowering spike occasionally attains the length of 40 or 50 cm. Petals somewhat persistent. Stamens four, very rarely six. Fruit 2 mm. long and 1½ to 1¾ mm. wide. Carpels two-keeled and usually a little scabrate on the back.

Ontario, New York, south to Florida, New Mexico and Mexico, west to Ohio and Minnesota.

8. *M. hippuroides.* Nutt. in Torrey and Gray Fl. 1, 530 (1840).

M. scabratum. Cham. Linnæa 4, 506, not Michaux.

Leaves in whorls of fours and sixes, sometimes scattered, the floral 8 to 12 mm. long, linear-lanceolate, serrate or dentate, uppermost nearly or quite entire, lowest pinnatifid ; submerged, with six to eight pairs of capillary pinnæ. Monoecious, but occasionally with only one kind of flowers on the stems, and so appearing diœcious. Petals often pink-colored, sub-persistent. Stamens four. Fruit about 2 mm. long by 1 mm. or a little more in breadth ; carpels keeled and somewhat rough, with a deep groove between them. A western form nearly allied to our Atlantic *M. heterophyllum.* Coll. by Nuttall and Hall in the Wahlamet ponds, and by Howell at Sauvie's Island, Oregon, and by Chamisso near San Francisco, E. L. Greene, Stockton, and A. B. Simonds at Clear Lake, California.

9. *M. pinnatum.* (Walt.)

Potamogeton pinnatum. Walt. Fl. Car. 90 (1788).

M. scabratum. Michx. Fl. 2, 190 (1803), and most American authors.

Leaves in whorls of threes and fives, sometimes scattered, the floral linear, pectinate, toothed or cut-serrate, the teeth comparatively few, 5 to 15 mm. long, gradually changing into the submerged, which are in crowded verticils, the capillary pinnæ sparse. Spikes 10 to 20 cm. long. Petals purplish, somewhat persistent. Stamens four, very rarely six. Mature fruit about 1¾ mm. long, and 1¼ mm. broad. Carpels strongly two-keeled and scabrate on the back, the grooves deep.

Shallow water, Rhode Island to Florida, Louisiana, Texas and Missouri.

10. *M. Mexicanum.* S. Watson Proc. Am. Ac. 25, 148 (1890).

Stems stout, much branched. Leaves in verticils, or subverticils of fours and fives, or scattered, the floral pinnatifid or toothed, the divisions remote, 10 to 15 mm. in length ; submersed pinnatifid, 20 to 30 mm. long, the divisions finely capillary, very long, in seven to ten pairs. Spikes 10 to 30 cm. in length, their lower portion often submerged.

A few of the intermediate flowers perfect. Petals oval, rose-colored. Stamens four. Fruit in specimens sent by the collector, Mr. Pringle, about 2 mm. long by 1 to 1½ mm. broad, the carpels sharply angled and ridged and occasionally scabrate on the back, with a deep, narrow groove between them.

No. 2,017, Pringle, Chihuahua, Mexico, Oct., 6, 1888.

11. *M. laxum.* Shutt. in Chapman Fl. 143 (1860).

Leaves in whorls of fours, the floral usually shorter than the flowers, the lowest pectinate-toothed or pinnatifid, the uppermost entire, linear or narrowly spatulate, sometimes all of them minute, leaving the spike apparently naked ; submerged 10 to 20 cm. in length, the capillary divisions about five on a side, and placed irregularly on the rachis. Petals pink, sub-persistent. Stamens eight. Fruit nearly 2 mm. long, by 1¼ mm. wide ; carpels rounded on the back, strongly tuberculate-rugose.

Ponds in middle and west Florida (Chapman).

12. *M. Farwellii.* Morong.

Recently published in these columns—BULL. TORR. BOT. CLUB, for May, 1891. Collected by O. A. Farwell on the Keweenaw Peninsula, Michigan.

Intra-carpillary Pistils and other Floral Derangements.

BY BYRON D. HALSTED.

Plate CXXI.

The normal *Petunia* flower is five-merous with its stamens adherent to the corolla tube for one half their length. In the double varieties, instead of these five stamens there may be from none to seven perfect ones, with a range of from one to fifteen which are partly transformed into petals. An average of fifteen blossoms gave 3.7 perfect stamens, and 5.3 more or less petaloid. As the corolla proper is trumpet shaped, the transformed stamens have but little space in the tube, and the petaline structures, therefore, are usually much twisted and contorted, especially for the lower portion, and frequently they are united to each other and to the inner wall of the surrounding corolla. In studying these peculiar flowers as found in abundance in the gardens, my attention was drawn to the unusual size of the petals, which, instead